Craig Schmitt

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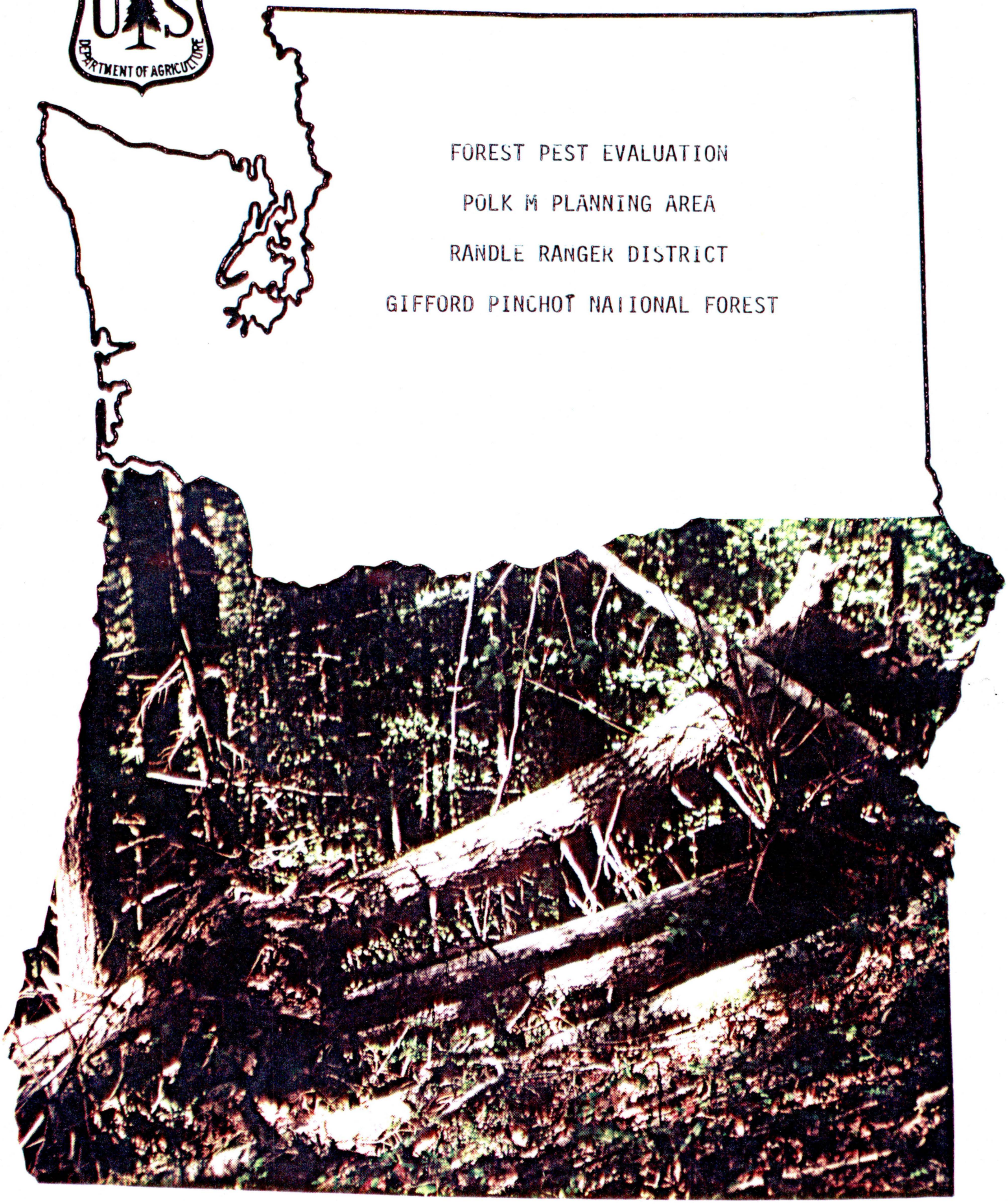
Forest Pest Management
Pacific Northwest Region



FOREST PEST EVALUATION

POLK M PLANNING AREA

RANDLE RANGER DISTRICT

GIFFORD PINCHOT NATIONAL FOREST

1985

FOREST PEST SURVEY
POLK M PLANNING AREA
RANDLE RANGER DISTRICT
GIFFORD PINCHOT NATIONAL FOREST

by

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Appreciation is extended to Don Goheen, Bob Harvey, and David Cobb, from Forest Pest Management, for their assistance in collecting field data.

INTRODUCTION

During January 7 to 10, March 11 to 14, and May 20 and 21, 1985, a Forest Pest Management crew surveyed portions of the Polk M Planning Area (T. 13 N., R. 9 E., secs. 8, 9, 10 and 11), Randle Ranger District, Gifford Pinchot National Forest (Figure 1). As a result of observations in the area, Gary Wright of the District Silviculture staff had suspected a high incidence of root disease in these stands and requested assistance in determining locations of disease centers, ascertaining levels of damage, and formulating management alternatives for reducing current and future losses.

Site and Stand Characteristics

The Polk M Planning Area is located on south aspects facing the Cispus River between North Fork Campground and Camp Creek. It contains approximately 1500 acres, with elevation ranging from 1300 to 3000 feet. Terrain varies from flat ground at the valley bottom to steep side slopes. Most of the hillsides average 60 percent slope and have numerous rock outcrops and cliffs. Soils are very light and porous, containing a large proportion of volcanic tuff. Site quality is good. Roads and a highway are present at the base of the area and at, or near, the upper portions of the unit. The interior of this area has never been accessed.

Most of the area burned in the Cispus Fire approximately 67 years ago. The stands that now occur on the sideslopes are predominantly 60- to 70-year-old Douglas-fir that were regenerated naturally after the fire. In portions of the valley bottom, many trees survived the burn. In these stands conifer species include mature to overmature Douglas-fir, western hemlock, western redcedar, and grand fir. Hardwoods, including bigleaf maple, vine maple and red alder, are also common in the stands, though alder is not common on the steeper slopes. Past management entries have been limited to salvage logging in stands at the valley bottom.

METHODS

Three blocks (Figure 2) were surveyed. Each was surveyed separately. A systematic survey of one block (A) and a portion of another (B) was accomplished by spacing variable radius plots (BAF 40) at 10-chain (660 ft.) intervals along transects located 5 chains apart. Plots were not located throughout all of Unit B or any of Unit C because of time constraints. A Spiegal-Relaskop was used to define each plot. Plots were inspected for dead, dying, and symptomatic trees affected by pests. Diagnosing pests on individual trees involved (a) removing a section of bark from the boles of dead trees to check for bark beetles or their galleries, and (b) exposing one or more large roots to check for stained wood or mycelia of root disease fungi. On plots where dead or symptomatic trees were identified, the following were recorded for only those trees: species, DBH, condition (dead or alive), and the presence and identity of pathogen(s). A basal area count was then made of other trees in the plot. Every tenth plot was a "count" plot in which previously mentioned data were collected on all trees. From data collected at plots, mean basal area and number of trees per acre were calculated by species, DBH class, condition and, when appropriate, cause of decline or death. Differences in basal area stocking between disease and healthy plots were also determined.

In addition to establishing plots, surveyers scrutinized the entire survey area for pest-caused mortality. This was done by reconnoitering a 2-1/2-chain-wide strip on either side of the transect. Root disease centers were mapped with boundaries based on the furthest extent of dead or symptomatic trees. In Block C and the portion of B in which plot data were not taken, our survey involved only transect reconnoitering and map preparation.

RESULTS AND DISCUSSION

The survey revealed extensive root disease in each of the three blocks. Laminated root rot, caused by Phellinus weirii, was the most common disease present. Damage seen as outright mortality, as well as understocking in disease centers, was widely distributed. Laminated root rot was detected on 12.1 percent of the Douglas-fir basal area. Difficulty in detecting signs or symptoms of the disease on all but severely infected trees results in underestimates of amount of infection. Plots with at least one laminated root rot-affected tree had only 79 percent as much basal area as did healthy plots.

Most laminated root rot centers averaged less than 1 acre in size, though several large centers were found, including one of approximately 2.5 acres in Block A. Mostly dead down and dead standing trees were found within centers. Symptomatic trees commonly observed around the perimeter of centers indicated most of these centers were expanding.

A minor amount of Armillaria root disease, caused by Armillaria (mellea) ostoyae, was found on occasional scattered trees and in small centers. Mean basal areas and number of trees per acre are shown in Tables 1 and 2.

Douglas fir beetles (Dendroctonus pseudotsugae) were frequently found associated with root disease-caused mortality. Beetle-killed trees were often adjacent to, or within root disease centers.

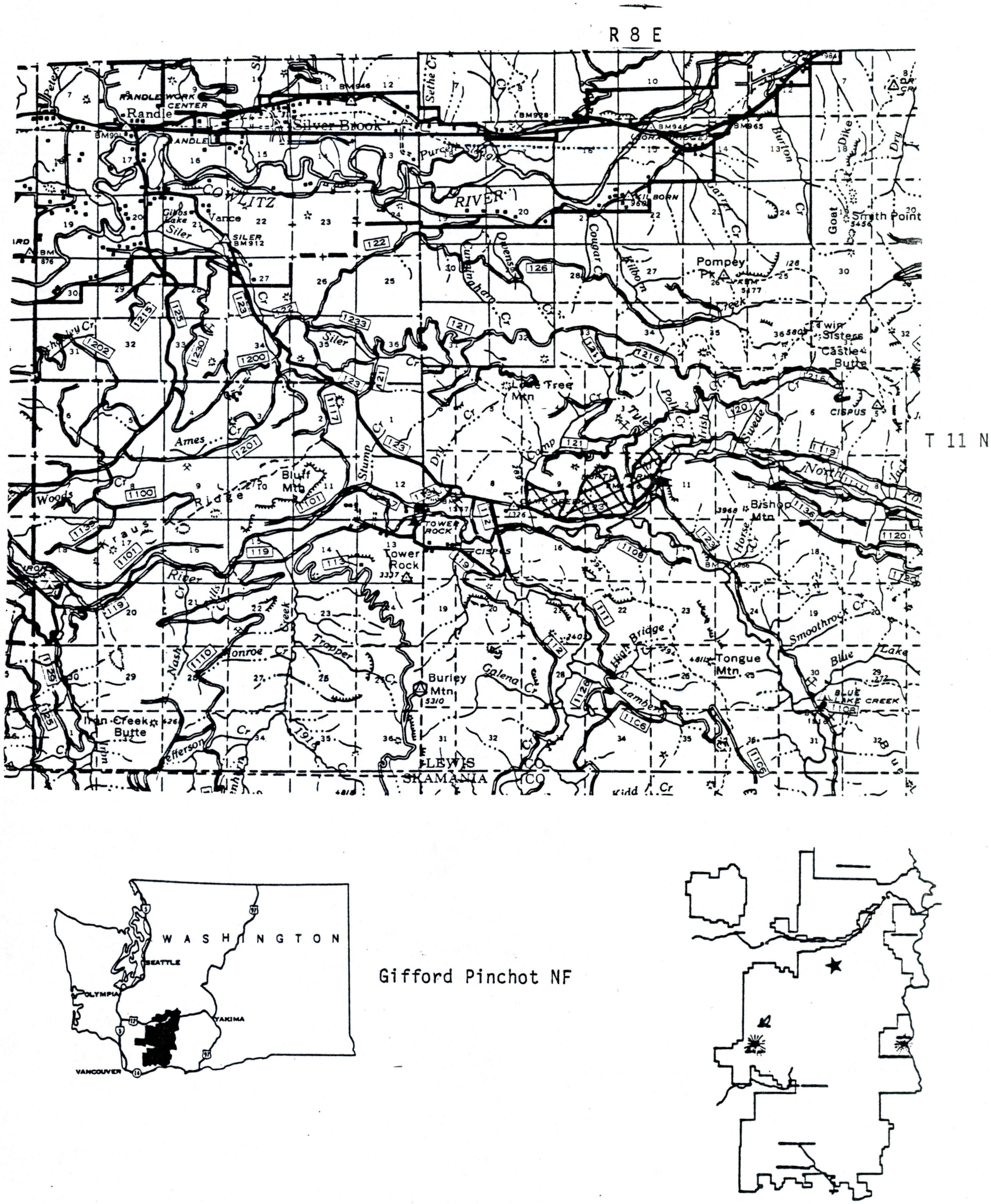

R 8 E
T 11 N
Randle
RANDLE WORK CENTER
Silver Brook
COWLITZ
RIVER
Vance
Gibbs Lake
Siler
SILER BM912
KILBORN
Pompey Pk
Smith Point
Goat Cr
Twin Sisters
Castle Butte
Cougar Cr
Kilborn
Queets Cr
Purcell Slough
Burton Cr
Dike
Dry
Lone Tree Mtn
Camp
Tyler Cr
Polk Cr
Irish
Swede
CISPUS
North
Bishop Mtn
Ames Cr
Bluff Mtn
Woods Cr
Ridge
Kraus
Stump Cr
Dry Cr
TOWER ROCK
Tower Rock
CISPUS
River
Horse Cr
Nash Cr
Monroe Cr
Tropper
Burley Mtn
Galena Cr
High Bridge
Tongue Mtn
Lambert
Smoothrock Cr
Blue Lake
BLUE LAKE CREEK
Iron Creek Butte
Jefferson
LEWIS
SKAMANIA
CO
WASHINGTON
SEATTLE
OLYMPIA
YAKIMA
VANCOUVER
Gifford Pinchot NF

Figure 1. Maps depicting location of the Polk M Evaluation (cross-hatching and star), Randle Ranger District, Gifford Pinchot National Forest.

RANDLE RANGER DISTRICT

GIFFORD PINCHOT NATIONAL FOREST

POLK M FOREST PEST EVALUATION

AREA MAP

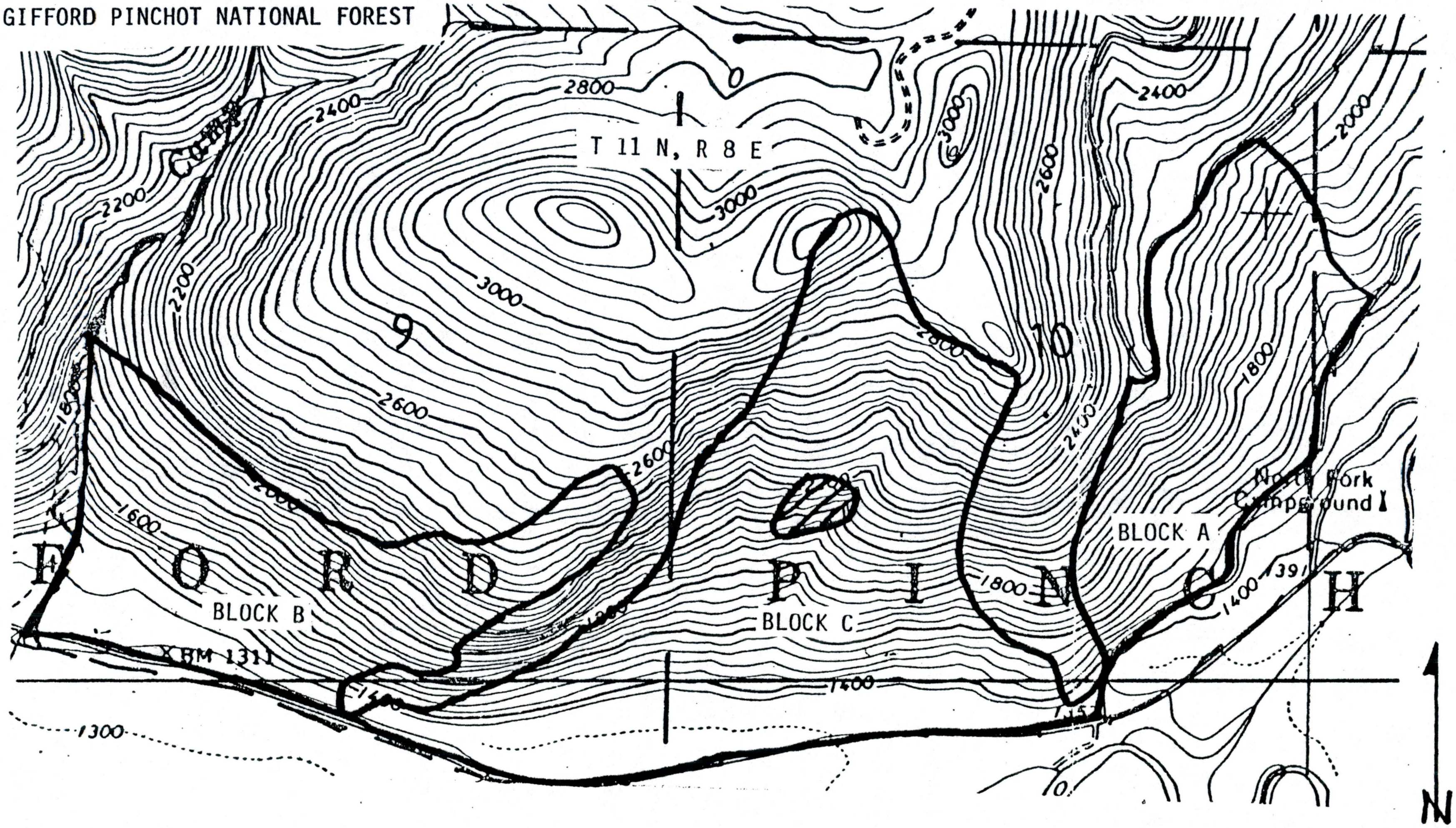
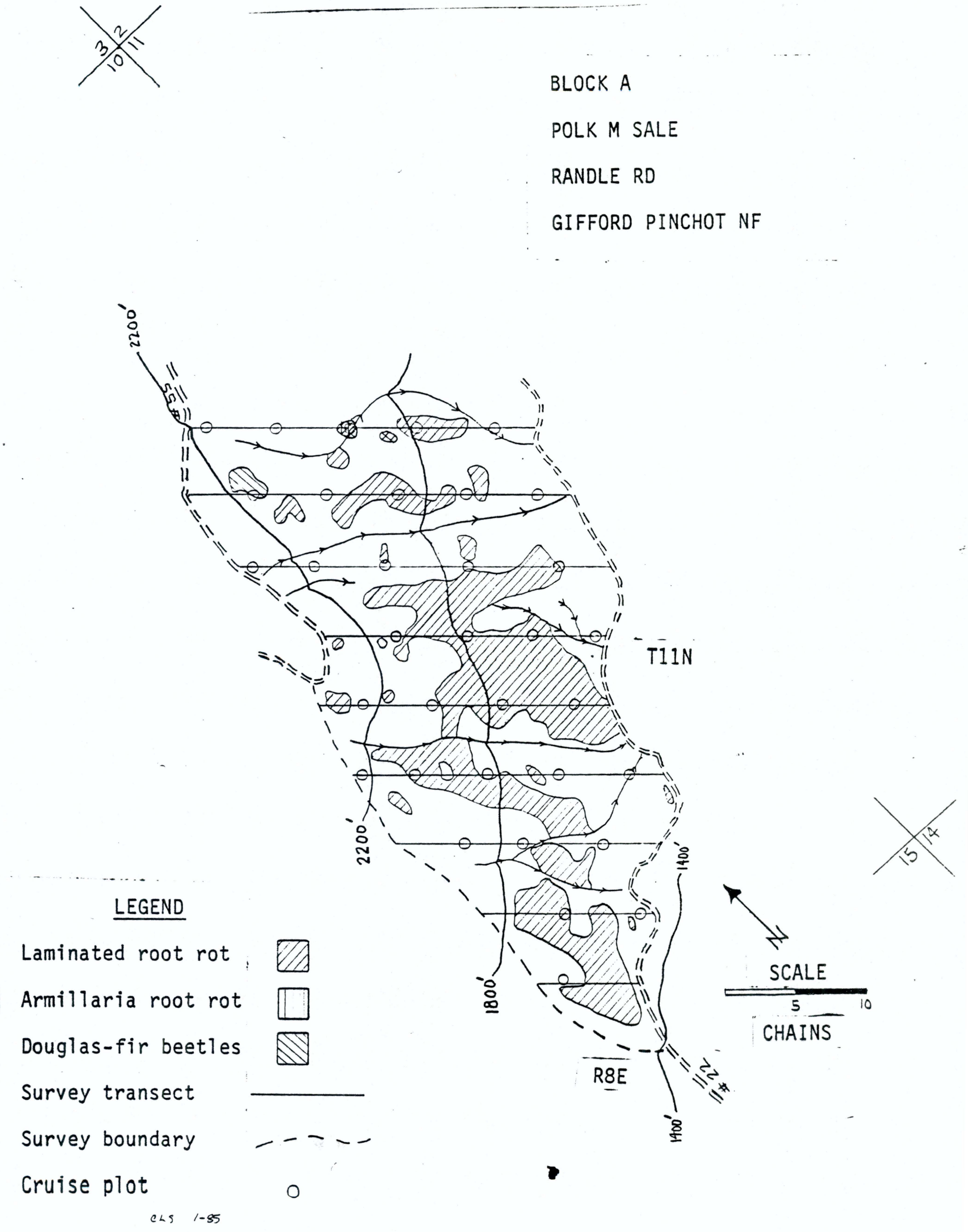

2800
2400
T 11 N, R 8 E
3000
2600
2200
2000
1800
1600
1400
1300
9
10
BLOCK A
BLOCK B
BLOCK C
North Fork Campground
BM 1311
GIFFORD PINCH
N

Figure 2. Map depicting location of surveyed blocks within the Polk M Planning area.

LOCATION OF PEST-CAUSED DAMAGE

BLOCK A
POLK M SALE
RANDLE RD
GIFFORD PINCHOT NF


3 2
10 11
2200'
55
2200'
1800'
1400'
1400'
22 #
T11N
R8E
15 14
N
SCALE
5
10
CHAINS
LEGEND
Laminated root rot ▨
Armillaria root rot ▥
Douglas-fir beetles ▧
Survey transect
Survey boundary
Cruise plot ○

CLS 1-85

FIGURE 3

BLOCK B

POLK M SALE

RANDLE RD

GIFFORD PINCHOT NF

LOCATION OF PEST-CAUSED DAMAGE

LEGEND

Laminated root rot	▨
Armillaria root rot	▧
Douglas-fir beetles	▤
Survey transect	───
Survey boundary	- - -
Cruise Plot	○

CLS 1/85

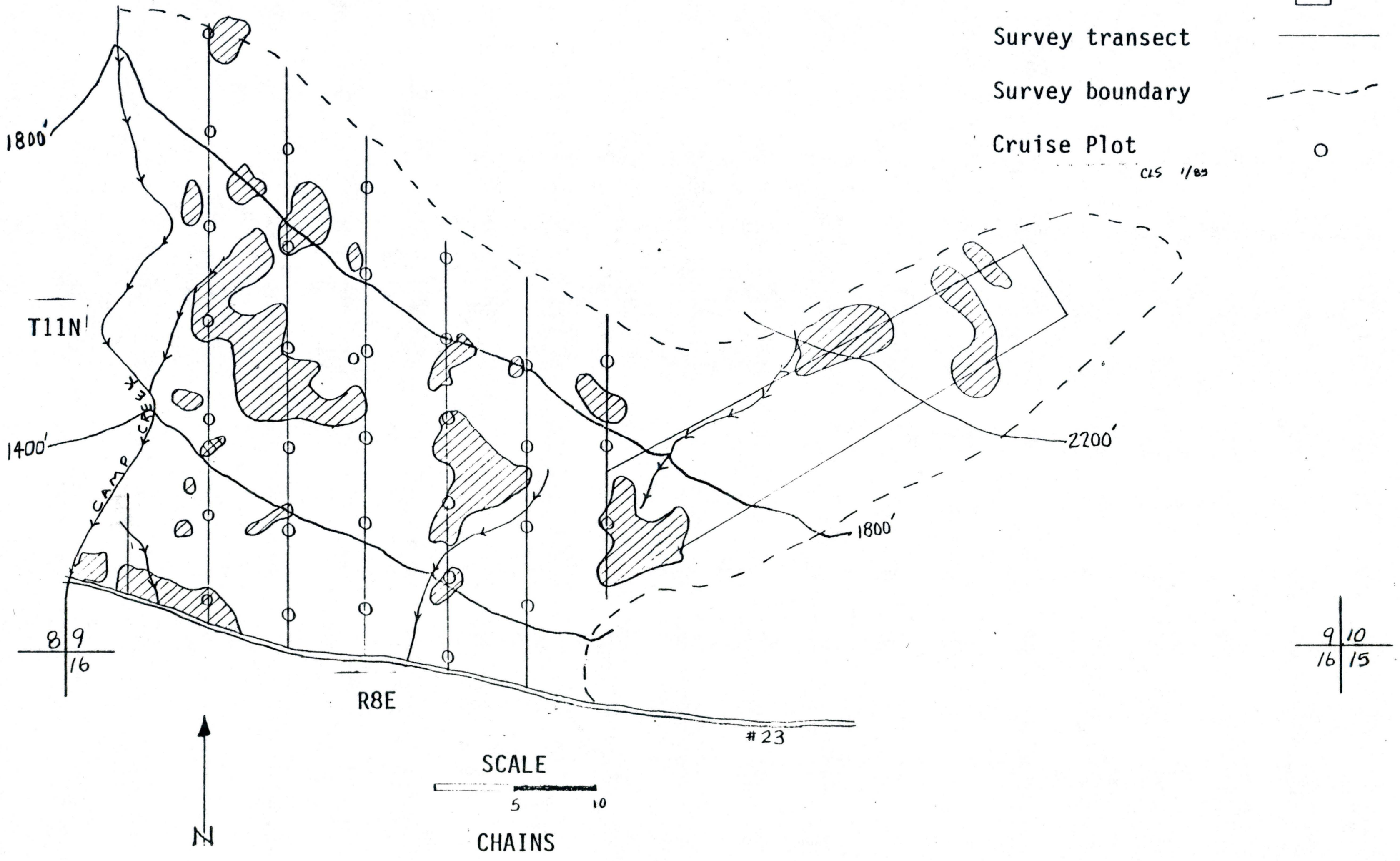

1800'
T11N
1400'
CAMP CREEK
8 9
16
R8E
#23
2200'
1800'
9 10
16 15
SCALE
5
10
CHAINS
N

FIGURE 4

LOCATION OF ROOT DISEASE DAMAGE

BLOCK C

POLK M AREA

RANDLE RD

GIFFORD PINCHOT NF

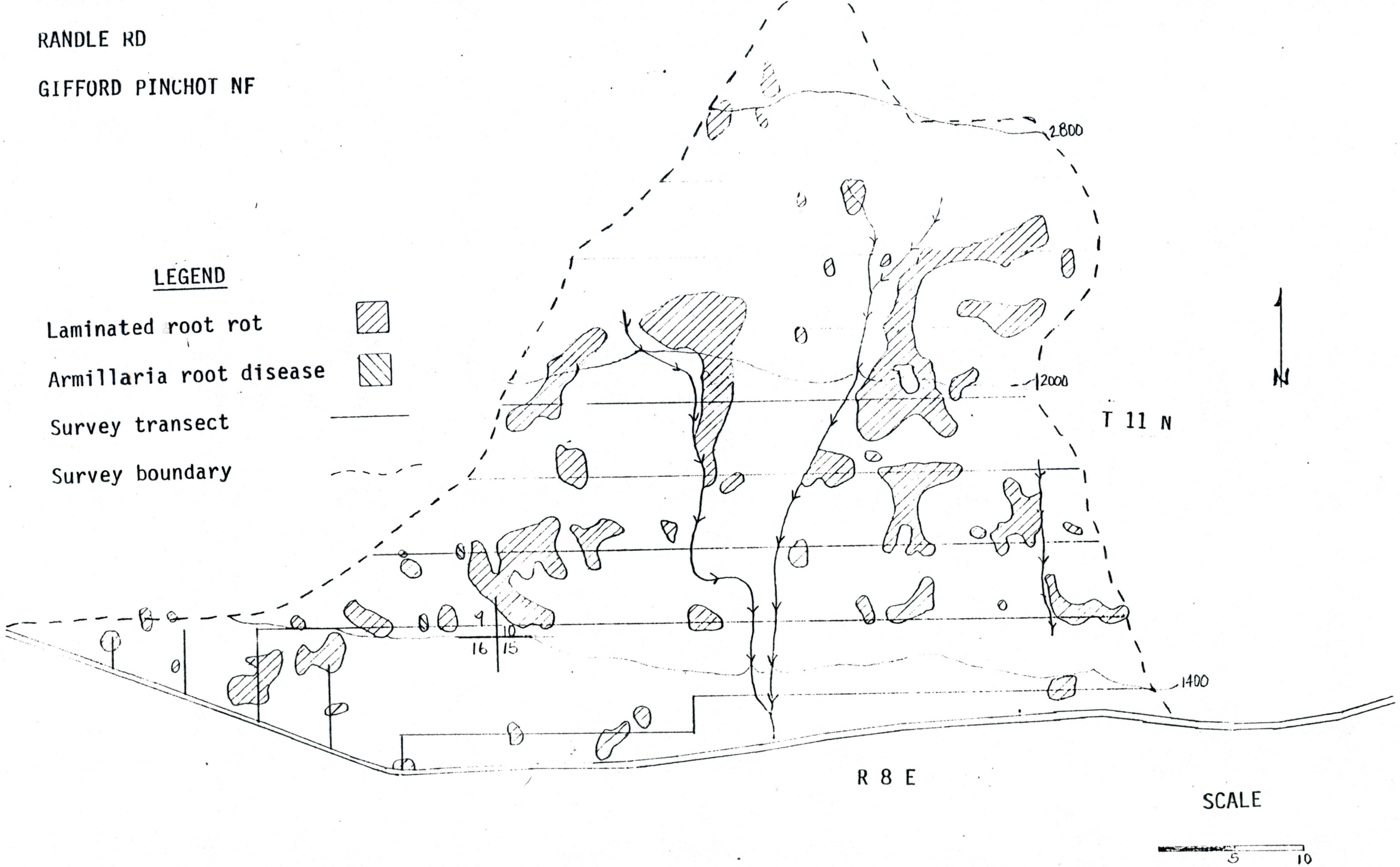

LEGEND
Laminated root rot ▨
Armillaria root disease ▨
Survey transect
Survey boundary
2800
2000
1400
9
10
16
15
T 11 N
R 8 E
N
SCALE
5
10
CHAINS

FIGURE 5

Basal and bole girdling by black bears has caused some losses in the survey stands. Most damage is in the higher portions of all the survey blocks on young trees. Only a minor amount of bear damage is recent. Most occurred some time ago. As is usually the case, bear damaged and killed trees were the dominant individuals in the stands.

Other pests found causing minor amounts of loss within plots included red-brown butt rot, caused by *Phaeolus schweinitzii* and red-ring rot, caused by *Phellinus pini*. Both of these diseases are likely to become more common as the stands grow older (especially in excess of 120 years old). Damage will also increase, but the level of losses is not expected to be excessive.

DISEASE BIOLOGY AND IDENTIFICATION

Laminated Root Rot

Laminated root rot is a common disease in Pacific Northwest stands. In western Washington and Oregon, it is by far the most damaging forest disease, with centers estimated to occupy about 5 percent of the West Side Douglas-fir type. Infected young, small sawlog-sized stands usually are understocked as a result of the disease. Extensive mortality may reveal the presence of disease centers. Resistant brush and hardwood species, including vine maple, bigleaf maple and alder, and less susceptible conifers, such as western hemlock, will usually start growing within understocked, diseased areas.

Phellinus weirii damages its hosts by attacking, killing, and decaying their roots. *P. weirii* spreads on the surface of roots, grows to the root collar, then spreads to other roots. The period of time from initial infection to mortality is somewhat proportional to the size of the tree. During the time between initial infection and death, rate of tree growth diminishes.

Mortality frequently results from windthrow of trees that have a portion of their root systems decayed. On more sheltered aspects, trees may die standing or topple when most of their structural support is gone. Bark beetles will frequently attack dying trees, resulting in quickened tree death.

Variability in species susceptibility exists in western Washington mixed-conifer stands. The most susceptible species in the survey area are Douglas-fir and grand fir; western hemlock is intermediately susceptible. Western white pine, a very minor stand component in this area, is tolerant to *P. weirii*. Western recedar is resistant.

Diseased windthrown trees will frequently exhibit root balls, remnants of root systems that are decayed and broken off just below the root collar. Exposed decayed wood will usually have characteristic delaminations along the annual rings, pitting, and growth of reddish-brown setal hyphae between the sheets of decayed wood (Plate 1).

Living-diseased and recently-killed trees will often have whitish, crusty ectotrophic mycelia of the fungus growing on the surface of infected roots. On larger roots of older trees, this mycelia often is found in bark crevices (Plate 2).

P. weirii can survive as a saprophyte for up to 50 years in dead host material (large roots and stumps). New infections occur when roots of healthy susceptible trees contact this material. Laminated root rot can thus remain on the site, affecting subsequent generations. Centers develop when the pathogen grows from diseased trees and infects healthy trees via root contacts or grafts. The rate of radial expansion can be as much as 1 to 2 feet per year. Stocking stands with less susceptible species may slow the rate of expansion.

Douglas-fir Beetle

The Douglas-fir beetle is an opportunistic insect, usually maintained at endemic levels on storm-damaged, windthrown, and disease-weakened trees in which it feeds and reproduces. When a large amount of host material becomes available and conditions are favorable, outbreaks involving healthy, vigorous trees develop. Outbreaks in healthy trees usually decline rapidly over a 2- to 3-year period.

The Douglas-fir beetle has one generation annually. Adults and some large larvae overwinter. The adults emerge and attack from April to June. Some adults reemerge and attack additional trees. Adults from overwintering larvae emerge and attack in July and August.

In western Washington, host vigor is the main factor which affects Douglas-fir beetles. Numerous low-vigor trees favor population buildups.

Red-Brown Butt Rot

Red-brown butt rot caused by *Phaeolus schweinitzii* is common in mature to over-mature Douglas-fir. The fungus causes decay of the root system and butt of its host. The pathogen is usually not very aggressive, and tree decline is slow following infection. Tree mortality usually results from windbreak as a result of the decay. One, or more, other pests may be associated with mortality. Special control measures are seldom required. Reinfection of new stands following harvest and regeneration may occur; however, serious decay is not believed to occur until trees reach ages in excess of 120 years.

The presence of "velvet-top" fruiting bodies is the best indicator of the disease. Trees which have windthrown or snapped at the base will exhibit the characteristic brown cubical rot caused by this fungus.

Red-Ring Rot

Red-ring rot, caused by *Phellinus (Fomes) pini*, is a stem decay found in many conifer species. Individual trees will often have extensive decay throughout the bole. Losses increase with stand age, both as a result of number of trees infected and the amount of decay within each tree. Wood with advanced decay retains some structural strength and currently has some uses, such as plywood core. Infected trees can be identified by the presence of fruiting bodies and, in some cases, swollen "punky knots." Spread of disease is by airborne spores infecting trees through branch stubs and possibly wounds.

Armillaria Root Disease

Armillaria root disease of conifers, caused by Armillaria (mellea) ostoyae, is found throughout the Northwest on many hosts. In western Washington, this disease most commonly is found in plantations, especially where offsite stock was planted or local stock was poorly planted. Stressed trees of most species and of all age classes are susceptible to attack. Douglas-fir is most susceptible when it is less than 30 years old. Occasionally, virulent strains of this fungus cause unusually large amounts of mortality. In most cases, however, A. ostoyae will be damaging only one species in a stand. In maturing Douglas-fir stands, Armillaria root disease is most frequently found causing low levels of damage.

Crown symptoms caused by Armillaria root disease include thin chlorotic foliage and a distress cone crop. Resinosis around the base of the bole is very common. Cream-colored mycelial fans are found growing under the bark of the lower bole on the root collar and the roots of infected trees (Plate 3). These can also be found on trees which have been dead for up to 3 years. The presence of rhizomorphs is also very diagnostic.

Table 1: Mean Basal Area (ft.^{2}) and Trees per Acre by Diameter Class, Species, and Tree Condition, Polk M Area

DBH CLASS	DOUGLAS-FIR				WESTERN HEMLOCK		WEST.REDCEDAR	
	ALIVE		DEAD		ALIVE		ALIVE	
	BA	T/A	BA	T/A	BA	T/A	BA	T/A
4	20.0	229	2.0	5.6				
6	6.7	34	2.0	3.6				
8	0	0	3.3	4.2				
10	10.0	18	4.6	4.2				
12	29.3	37	1.3	0.9	6.7	8.5		
14	40.7	38	2.0	1.0				
16	34.6	25	0.7	0.3				
18	29.3	16	0.7	0.3				
20	10.0	5			6.7	3.1		
22	7.4	1						
24	1.3	1						
30			0.7	0.1				
36			0.7	0				
40	6.7	1	0.7	0				
44	6.7	1						
50	6.7	1						
56	6.7	1						
70							6.7	.25
TOTALS	216.1	406	18.7	20.2	13.4	11.6	6.7	.25

Table 2: Mean Basal Area ($ft.^2$) and Trees per Acre by Pest, Condition and Diameter Class, Polk M Area

DBH CLASS	LIVING TREES WITH								DEAD TREES WITH:					
	P. WEIRII		P. PINI		A. OSTOYAE		P. SCHWEINITZII		P. WEIRII		A. OSTOYAE		D. PSEUDOTSUGAE	
	BA	T	BA	T	BA	T	BA	T	BA	T	BA	T	BA	T
8									1.3	4	0.7	2		
10	3.3	6			1.3	3			1.3	3	0.7	1		
12	2.6	3							3.3	4				
14	0.7	1							4.6	4				
16	1.3	1												
18	2.0	1			0.7	1			2.0	1				
20	3.3	2											0.7	0.3
22	0.7	<1							0.7	<1				
24	1.3	<1												
30													0.7	<1
36													0.7	<1
40							0.7	<1						
48			0.7	<1										
50			0.7	<1										
TOTALS	15.2	15	1.4	1	2.0	4	0.7	<1	13.2	16	1.4	3	2.1	<1

MANAGEMENT ALTERNATIVES

Laminated root rot is causing severe losses throughout most of the survey area. High levels of infection occur in each of the three survey blocks. Understocking, mortality, and growth loss are the results of this disease. Douglas-fir beetles have killed and will continue to kill trees, largely because of predisposition by laminated root rot. Other pests, such as Armillaria root disease, are less damaging, but damage caused by pests such a P. schweinitzii and P. pini will continue to increase in severity as the stand matures. To minimize present and future losses, management action should concentrate mainly on reducing the level of laminated root rot.

Due to the slope and south-facing aspect, few tree species are adapted to these sites, but the sites will have to receive some form of disease treatment if maximization of timber production is a goal. The presence of this root pathogen complicates present and future management options for this stand.

The following management alternatives are formulated for the Polk M Area, based on disease, stand, and site characteristics:

1) Defer Treatment

Timber losses caused by laminated root rot have been substantial and will continue into the future. By deferring treatment, the following can be anticipated:

A) Already-infected trees will probably die within 50 years. Trees will continue to become infected. However, mortality rates among newly-infected trees will probably be lower. This is because it takes longer for larger trees to succumb to the disease.

B) Laminated root rot centers will continue to expand laterally at the rate of 1 to 2 feet per year.

C) Root disease-induced windthrow will be minimized as a result of keeping the stand closed.

D) Opportunities for salvaging windthrow and mortality are minimal because of limited access.

E) Yield will be reduced.

F) Possibility of managing a fast-growing species within treatment areas is lost.

G) Level of inoculum in the soil will continue to grow, increasing the costs involved in treating the problem. Size of infected stumps and roots will also increase, lengthening the period required before Douglas-fir could be replanted.

2) Intermediate Entry Option

Using this option, portions of the area, identified by criteria not including disease incidence, would be commercially thinned. No attempt would be made to identify diseased areas on the ground or to treat them differently from other portions being thinned. By carrying out this action, the following can be anticipated:

A) Disease centers will continue to spread laterally at a rate of 1 to 2 feet per year.

B) Upon opening the stand, windthrow of diseased trees may increase. Windthrow will probably continue as the stand matures. Windthrow serves as a mechanism for removing some of the inoculum from the soil and breaking roots left in the ground, thereby hastening deterioration and replacement of P. weirii. This may result in a slightly decreased amount of inoculum.

C) Accessing and thinning the stand may make salvaging of future disease-caused mortality and windthrow easier.

D) Level of inoculum in the soil will continue to grow, increasing the costs involved in treating the problem.

E) Yield will be greater than with the defer-treatment option.

3) Clearcut Option

Using this option, portions of the area, identified by criteria not including disease incidence, would be clearcut and replanted to Douglas-fir. No attempts would be made to identify diseased areas on the ground or treat them differently from other portions. By implementing this action, the following can be anticipated:

A) Many Douglas-firs planted in disease centers will become infected and not reach maturity. Initial infection from remnant stumps and roots would in turn spread from tree to tree in the new stand.

B) Area actually within disease centers would continue to increase.

C) Level of inoculum in the soil will continue to grow, increasing the impact upon future stands.

D) Yield within disease centers at stand maturity is estimated to be 40 percent of normal.

4) Disease Management Option A

This alternative will employ management strategies aimed at improving timber yield by slowing disease spread and returning severely infested sites to nearly full production. Large disease centers or large blocks containing numerous smaller centers would be clearcut. Areas not in clearcut blocks would be thinned. Clearcuts would be replanted to less disease-susceptible species, such as adapted hardwoods (bigleaf maple, red alder), which are immune to laminated root rot or, possibly, conifers, such as western hemlock, which is intermediately susceptible, or western white pine, which is tolerant of infection. Clearcut areas would be planted with a fast-growing resistant species. The following are suggested steps involved in implementing this option:

A) Plan clearcut units using information on location and intensity of laminated root rot infection provided in Figures 3 through 5. Areas to be treated should include large centers and/or concentrated groups of smaller ones.

B) Plan commercial thinning in remaining stands. These stand should either be healthy or have only small, scattered disease centers. Small centers should be treated by removing all Douglas-fir from within 30 feet of dead or symptomatic trees.

C) Locate on the ground stands to be clearcut. Boundaries should include a buffer at least 30 feet beyond symptomatic trees on the periphery of centers within the unit.

D) Have marking crews trained in root disease recognition. Root disease centers should be identified on the ground during marking using disease incidence maps as an aid. Douglas-firs should not be marked for leave trees within disease centers and buffers. Buffers should be approximately two normal tree spacings (approximately 30 ft.) out from the periphery of centers as identified by symptomatic trees. Hardwoods, especially bigleaf maple, should be managed in resulting openings until a final harvest in approximately 40 years. Douglas-firs would have to be excluded from the cleared areas for the full 40 years. At that time, the infection potential of *P. weirii* which remained in the roots and stumps should be low enough that minimal reinfection would occur and Douglas-fir could be reestablished.

E) Clearcut areas would have to be treated to minimize hazard from reinfection if Douglas-fir is to be immediately replanted in areas currently infested with *P. weirii*. Due to equipment limitations, stump removal is not a viable option on steep slopes. Another option is stump fumigation. This would involve treating individual stumps with chemicals such as chloropicrin, Vapam, or Vorlex, which diffuse throughout the root system, killing the fungus. This is an experimental control method which has yet to be tested on an operational basis.

Regenerating the site with adapted, less-susceptible species is another option. Unfortunately, few are available. On exposed slopes, bigleaf maple, and possibly western white pine are alternatives. On less exposed aspects and on benches and flats, red alder and western hemlock are options.

By implementing this action, the following can be anticipated:

A) Spread of P. weirii will be halted in properly identified pockets and buffers which are treated.

B) By opening the stand, unidentified infected trees would be subjected to increased chance of windthrow. This would serve to remove some inoculum from the soil and possibly help identify additional infected areas.

C) Salvaging of any additional mortality, when near roads, would be possible.

D) Yield, both current and future, would be maximized.

E) If sites are treated, Douglas-fir, the highest value site adapted species, could be immediately reestablished.

F) Areas clearcut and planted to Douglas-fir will support a separate age class which will not be mature when surrounding stands are ready for final harvest. However, clearcuts planted to faster-growing hardwoods may be merchantable at that time.

5) Disease Management Option B

This alternative will attempt to halt spread of laminated root rot and grow a merchantable product while allowing the level of infective material in the soil to slowly diminish. Action would include removing Douglas-fir from disease centers, thinning in the remaining area, and managing the stands for an additional 40 years. At that time, Douglas-fir could be established throughout this area. The following steps should be made to implement this option:

A) Have marking crews trained in root disease recognition. Root disease centers should be identified on the ground during marking, using disease incidence maps as an aid. Douglas-fir should not be marked for leave trees within disease centers and buffers. Buffers should be approximately two normal tree spacings (30 ft.) from symptomatic trees on the periphery of centers within the unit.

B) Hardwoods, especially bigleaf maple, should be managed in resulting openings until a final harvest in approximately 40 years. Douglas-fir naturals would have to be excluded from the openings. At that time, the infection potential of P. weirii remaining in stumps and roots should be low enough that minimal reinfection would occur and Douglas-fir could be remanaged.

By carrying out this action, the following can be anticipated:

A) Spread of P. weirii will be halted in properly identified pockets and buffers which are treated.

B) By opening the stand, unidentified infected trees would be subjected to increased chance of windthrow. This would serve to remove some inoculum from the soil and possibly identify additional infected areas.

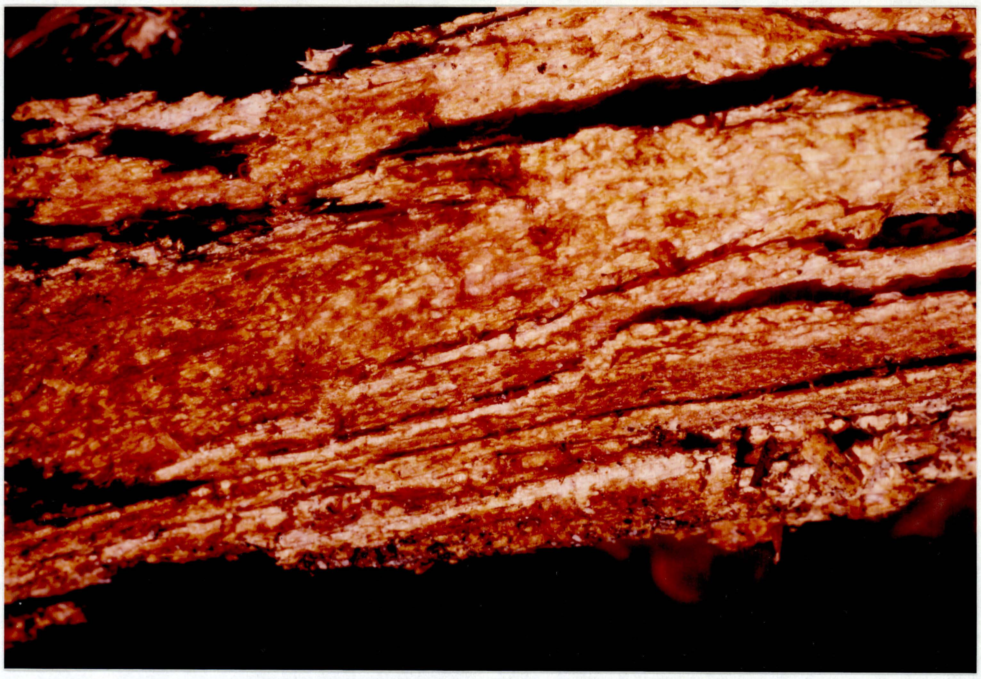
C) Salvaging of any additional mortality, when near roads, would be possible.

D) Yield, both current and future, would be increased.

E) Centers or portions of centers which are not detected on the ground may not be treated.

Disease Management Options A and B differ in the size of the treatment area. In Option A, large groups of centers would be treated. In Option B, emphasis would be on treating individual centers only. Our experience has shown that delineation of disease centers based on above-ground symptoms frequently results in an underestimation of the area infected. To minimize the potential for missing infected areas, especially around visible centers, Option A is recommended.

Plate 1. Setal hyphae characteristic of Phellinus weirii



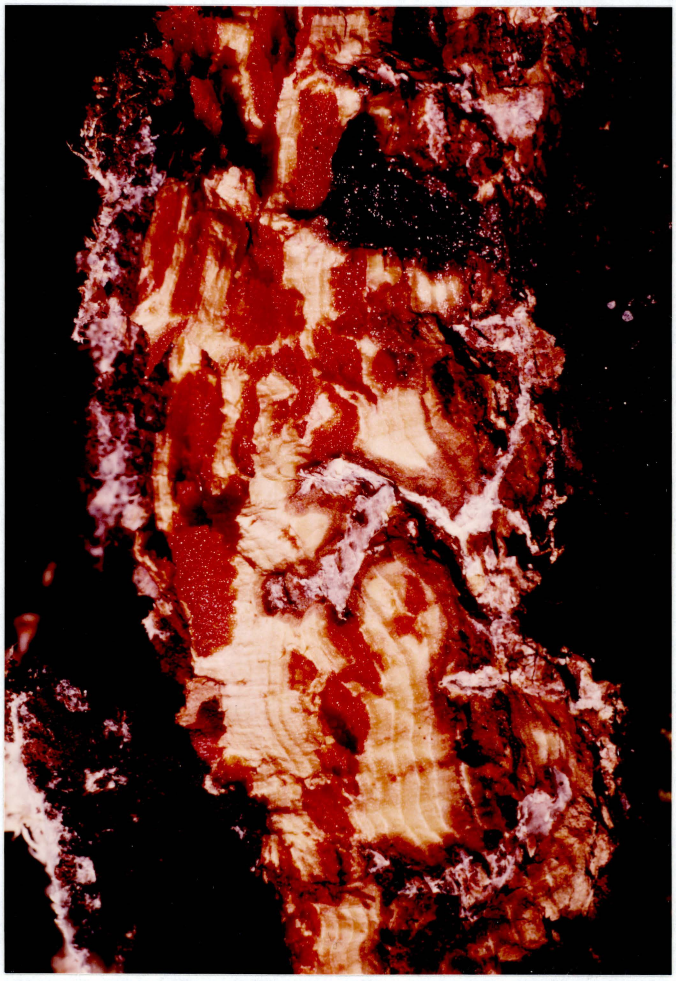


Plate 2. Ectotrophic mycelia in bark crevices on Douglas-fir roots characteristic of Phellinus weirii

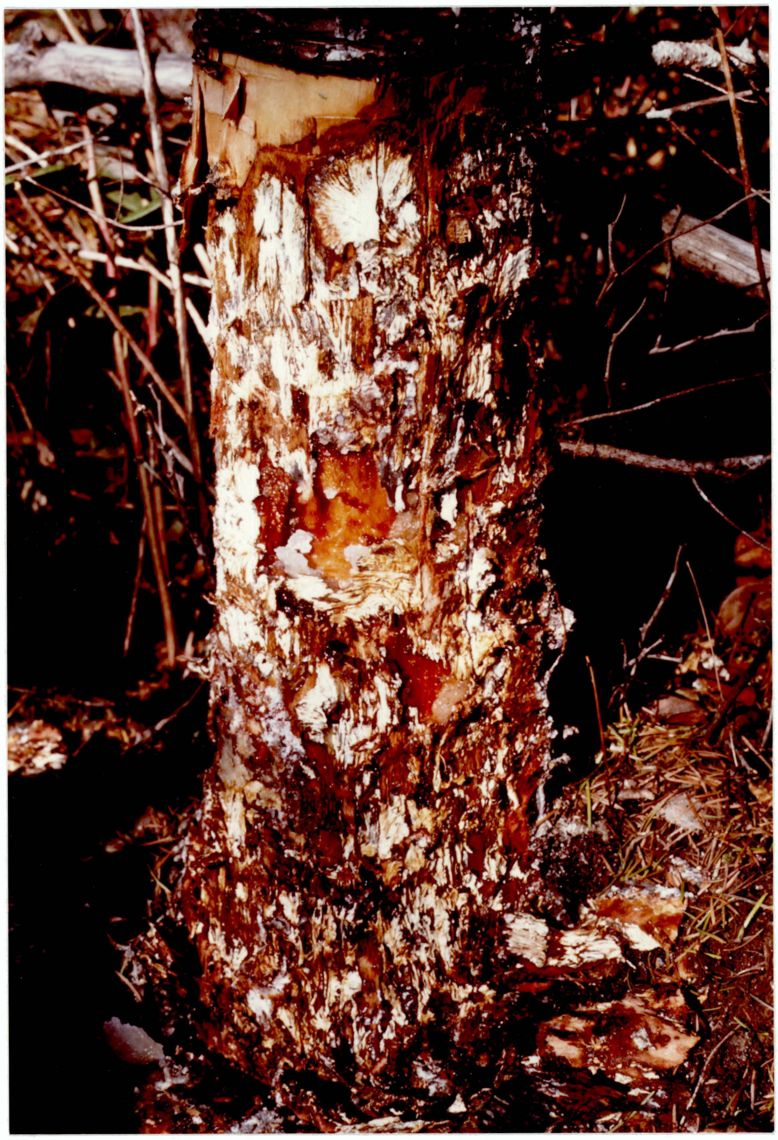


Plate 3. Mycelial fans of Armillaria (mellea) ostoyae

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Craig L. Schmitt, Plant Pathologist

11/15/85
Date

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Plant Pathologist

11/18/85
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Approved by: James S Hadfield
for Paul E. Buffam, Director
Forest Pest Management

11/25/85
Date